

Why Attitudes Are Not Enough: A Meta-Analysis of Waste Management Behaviour in Asia

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Abstract

Waste management has emerged as a critical environmental challenge across Asia, driven by rapid urbanisation, population growth, and shifting consumption patterns. This article examines pro-environmental attitudes toward waste management in Vietnam, China, Indonesia, Iran, and Japan through a meta-analytic framework grounded in the Theory of Planned Behaviour (TPB) and argues that, while pro-environmental intention is statistically significant, it is not robust across contexts. Additionally, TPB's linear attitude-intention-behaviour pathway is insufficient as a universal explanatory model because behavioural outcomes are fundamentally shaped by sociocultural norms, governance structures, and infrastructural capacity. Five primary studies were synthesised using a continuous random-effects model in OpenMEE, revealing a significant positive relationship between TPB constructs ($r = 0.348$, 95% CI: 0.263–0.434, $p < 0.001$), indicating a moderate association between intention and behaviour. Additionally, Comparative analysis using Cohen's d shows a large overall effect size ($d = 1.076$), with Vietnam recording the highest environmental attitude score and Japan the lowest, and the greatest disparity observed between these two countries ($d = 1.971$). This divergence suggests that explicit pro-environmental attitudes do not consistently translate into behavioural outcomes, particularly in contexts where behaviour is governed by internalised normative compliance rather than expressed intention. The consistently high heterogeneity ($I^2 > 97\%$) provides strong evidence that environmental behaviour is context-contingent rather than universally attitude-driven. Thus, effective waste management policies need to move beyond attitudinal interventions toward context-sensitive strategies aligned with country's psychosocial and institutional realities.

Keywords: meta-analysis, Theory of Planned Behaviour, environmental attitude, waste management



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I. INTRODUCTION

The waste problem has now become one of the most complex and urgent global environmental issues requiring a solution. The growing global population, massive urbanisation, changing consumer patterns, and industrial growth have significantly increased waste volumes each year. According to the World Bank's report in *What a Waste 2.0*, global solid waste generation is estimated to exceed 2.01 billion tons per year and is projected to rise to 3.40 billion tons by 2050 if consumption patterns and environmental management systems remain unchanged.² Additionally, the United Nations Environment Programme (UNEP) emphasises that plastic waste is one of the most serious environmental threats due to its long-term impacts on marine ecosystems, human health, and climate change.³

The Asian region is among the world's highest generators of waste, driven by its large population and rapid economic development. Developing countries in Asia face serious challenges in waste management because urbanisation is not always accompanied by an increase in waste management infrastructure capacity. This situation leads to various problems, including the accumulation of household waste, river and marine pollution, and increased greenhouse gas emissions from landfills. Jambeck et al. (2015) explain that several Asian countries, including Indonesia and China, are among the world's largest contributors of plastic waste to the ocean due to weak domestic waste management systems.

In Indonesia, the problem of waste, particularly plastic waste, has become increasingly alarming. The growth in public consumption of single-use products has increased the volume of plastic waste each year. According to data from the Ministry of Environment and Forestry (KLHK), the majority of domestic waste in Indonesia is still dominated by organic and plastic waste, while recycling rates remain relatively low. This problem is not only caused by limited waste management facilities but is also influenced by public behaviour that does not yet fully support sustainable waste management practices. Research by Widayat et al.⁴ shows that public awareness of the dangers of plastic has a positive relationship with pro-environmental attitudes and the intention to reduce the use of plastic packaging after consumption.

A relatively similar issue is also occurring in Vietnam. Increased tourism activity, coastal development, and changes in people's lifestyles have led to a rise in plastic waste generation, particularly in coastal tourist areas and on small islands. However, several studies indicate that community-based interventions can increase public awareness of

² World Bank, *What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050* (2018), <https://openknowledge.worldbank.org/entities/publication/d3f9d45e-115f-559b-b14f-28552410e90a>.

³ United Nations Environment Programme, *From Pollution to Solution: A Global Assessment of Marine Litter and Plastic Pollution* (2021), <https://www.unep.org/resources/pollution-solution-global-assessment-marine-litter-and-plastic-pollution>.

⁴ W. Widayat et al., "Pro-Environmental Attitude and Recycling Intention in Indonesia," *Journal of Natural Resources and Environmental Management* 12, no. 3 (2022): 456–71.

environmental issues. Research by Nguyen et al.⁵ indicates that residents in the Cu Lao Cham Island tourist area exhibit a strong pro-environmental attitude, as environmental cleanliness is perceived to directly link to the economic sustainability of local tourism.

China, with the world's largest population, also faces significant challenges in managing domestic waste. Rising household consumption and industrialisation have driven rapid increases in waste volumes over the past two decades. The Chinese government has developed various policies, such as mandatory waste sorting, to increase public participation in waste separation. However, implementing these policies still faces obstacles, particularly in rural and mountainous areas. Wang et al.⁶ explain that household waste management success in China is heavily influenced by environmental attitudes, social norms, and adequate facility support.

Meanwhile, Iran faces waste management challenges due to urbanisation and changing consumption patterns among urban residents. The high volume of household waste calls for a more participatory management strategy. Research by Heidari et al.⁷ indicates that moral obligation, environmental motivation, and perceived behavioural control significantly influence people's intentions to sort household waste. These findings suggest that environmental behaviour is influenced not only by technical factors but also by psychological and social factors.

Unlike developing countries, Japan is often cited as a global model of success in waste management. Japan has strict regulations on waste sorting and implements the concept of the Sound Material-Cycle Society (SMCS) as the foundation for sustainable waste management. The Japanese public is known for its high level of discipline in sorting waste according to categories designated by local governments. However, several studies indicate that the high level of compliance among the Japanese public with the waste management system is not always reflected in high survey-based environmental attitude scores. Stanislawski et al.⁸ explain that the pro-environmental behaviour of the Japanese public is more influenced by social norms, collective culture, and internalised habits than by verbal expressions of environmental attitudes.

These various phenomena indicate that waste management cannot be viewed merely as a technical and infrastructural issue, but also as a matter of human behaviour. The success of waste management policies is heavily influenced by public participation in reducing, sorting, and processing waste at the source. Therefore, an environmental psychology approach is essential for understanding the factors that influence public behaviour regarding waste management. One of the most widely used theories to explain

⁵ T. T. H. Nguyen et al., "Community-Based Environmental Attitudes and Waste Management Behaviour," *Journal of Environmental Management* 311 (2026): 114–26.

⁶ X. Wang et al., "Determinants of Household Waste Sorting Behaviour under Mandatory Policy in China," *Resources, Conservation and Recycling* 198, no. 107112 (2025), <https://doi.org/10.1016/j.resconrec.2025.107112>.

⁷ A. Heidari et al., "Youth Motivations and Barriers to Plastic Waste Segregation Management. International Journal of Sustainable," *Development & World Ecology* 25, no. 6 (2018): 552–62.

⁸ B. M. Stanislawski et al., "Household Waste Segregation Behaviour in Japan," *Waste Management* 34, no. 11 (2014): 2108–14.

environmental behaviour is the Theory of Planned Behaviour (TPB), developed by Ajzen.⁹ This theory explains that individual behaviour is influenced by intention, which is shaped by three main factors: attitude toward the behaviour, subjective norm, and perceived behavioural control. In the context of waste management, TPB explains why someone intends to sort waste, reduce plastic use, or support recycling practices. Previous studies have shown that environmental attitude is a key factor in shaping the public's pro-environmental behaviour. However, the strength of environmental attitudes varies across countries due to cultural factors, levels of development, government policies, and social conditions. Developing countries tend to exhibit higher levels of environmental attitude because people face waste problems directly in their daily lives. Conversely, developed countries like Japan exhibit environmental behaviour that is more rooted in social norms and habits, so explicit attitude scores in surveys tend to be lower.

The differences in these research findings indicate distinct psychosocial dynamics in the formation of environmental attitudes among communities in the Asian region. Therefore, a synthetic approach through meta-analysis is necessary to obtain a more comprehensive picture of differences in pro-environmental attitudes across communities in different countries. Meta-analysis was chosen because it can combine the results of multiple quantitative studies, thereby producing stronger, more reliable effect estimates than individual studies. This study employs a random-effects model-based meta-analysis to compare public environmental attitudes in Vietnam, China, Indonesia, Iran, and Japan, based on studies utilising the Theory of Planned Behaviour framework. This study is expected to provide a deeper understanding of the relationships among environmental behaviour, sociocultural context, and waste management systems in the Asian region, thereby laying the foundation for the development of more effective and sustainable waste management policies.

A meta-analysis was chosen as the approach for this study because it can combine the results of various quantitative studies, thereby producing stronger and more reliable effect estimates than individual studies. This study uses a random-effects meta-analysis to compare the environmental attitudes of people in Vietnam, China, Indonesia, Iran, and Japan, based on studies that employ the Theory of Planned Behaviour. The objectives of this study are: (1) to analyze the relationships among TPB variables, including attitude variable to intention variable, PBC variable to intention variable and intention variable to behaviour variable in the context of waste management in Asia; (2) to comparatively analyze environmental attitude scores across the five Asian countries using Cohen's *d*; (3) to identify differences in the psychosocial mechanisms influencing the formation of pro-environmental attitudes in developing and developed countries; and (4) to formulate relevant policy implications based on the findings of the meta-analysis. This study is expected to provide a deeper understanding of the relationships among environmental behaviour, sociocultural context, and waste management systems in the Asian region,

⁹ Icek Ajzen, "The Theory of Planned Behavior," *Organizational Behavior and Human Decision Processes* 50, no. 2 (1991): 179–211, [https://doi.org/10.1016/0749-5978\(91\)90020-T](https://doi.org/10.1016/0749-5978(91)90020-T).

thereby laying the foundation for the development of more effective and sustainable policies.

II. ENVIRONMENTAL ATTITUDE: LIMITS AND DEBATES

Environmental attitude is defined as a psychological disposition expressed through the evaluation of the natural environment with a certain degree of approval or disapproval.¹⁰ This attitude is not merely knowledge about environmental issues, but rather a multidimensional construct that simultaneously involves cognitive aspects (beliefs and knowledge about environmental issues), affective aspects (emotions and feelings related to the environment), and conative aspects (tendencies or intentions to act in an environmentally friendly manner).¹¹ Schultz et al.¹² categorized environmental attitude orientations into three primary value structures through the Values, Beliefs, Norms (VBN) model: (1) biosentric orientation, which is concern focused on ecosystems and all living beings in general, regardless of their benefits to humans; (2) altruistic orientation, which is concern based on the well-being of fellow humans and future generations; and (3) egoistic orientation, which is concern for the environment only to the extent that it impacts one's own personal well-being. In the context of waste management in the Asian region, these three orientations are present in varying degrees depending on the local community's socio-economic and cultural conditions.

In the literature on green consumer behaviour, environmental attitude is recognized as one of the most consistent determinants in predicting individual engagement in sustainable waste management practices.¹³ Individuals with positive environmental attitudes tend to perceive waste management activities not as a burden, but as a moral responsibility that provides intrinsic psychological satisfaction.¹⁴ Nevertheless, the relationship between attitudes and actual behaviour is not always linear or consistent across all cultural contexts. This phenomenon is known as the attitude-behaviour gap, referring to the discrepancy between the expression of positive environmental attitudes and the actual actions individuals take.¹⁵ The attitude-

¹⁰ Taciano Milfont and John Duckitt, "The Environmental Attitudes Inventory: A Valid and Reliable Measure to Assess the Structure of Environmental Attitudes," *Journal of Environmental Psychology* 30, no. 1 (2010): 80–94.

¹¹ Lucy J. Hawcroft and Taciano L. Milfont, "The Use (and Abuse) of the New Environmental Paradigm Scale over the Last 30 Years: A Meta-Analysis," *Journal of Environmental Psychology* 30, no. 2 (2010): 143–58.

¹² P. Wesley Schultz et al., "Values and Their Relationship to Environmental Concern and Conservation Behavior," *Journal of Cross-Cultural Psychology* 36, no. 4 (2005): 457–75.

¹³ Sebastian Bamberg and Guido Möser, "Twenty Years after Hines, Hungerford, and Tomera: A New Meta-Analysis of Psycho-Social Determinants of pro-Environmental Behaviour," *Journal of Environmental Psychology* 27, no. 1 (2007): 14–25, <https://doi.org/10.1016/j.jenvp.2006.12.002>.

¹⁴ Patrick Hartmann and Vanessa Apaolaza-Ibáñez, "Consumer Attitude and Purchase Intention toward Green Energy Brands: The Roles of Psychological Benefits and Environmental Concern," *Journal of Business Research* 65, no. 9 (2012): 1254–63.

¹⁵ James Blake, "Overcoming the 'Value-action Gap' in Environmental Policy: Tensions between National Policy and Local Experience," *Local Environment* 4, no. 3 (1999): 257–78, <https://doi.org/10.1080/13549839908725599>; Anja Kollmuss and Julian Agyeman, "Mind the Gap: Why Do

behaviour gap occurs because actual behaviour is not determined solely by attitudes but is also influenced by external factors such as the availability of infrastructure, prevailing social norms in the surrounding environment, economic barriers, and an individual's capacity to engage in the behaviour. In Asian countries with inadequate waste management infrastructure, such as Indonesia, high pro-environmental attitudes often do not translate into actual behaviour because the public faces limitations in waste sorting and processing facilities. This phenomenon makes cross-national comparative studies using the TPB approach increasingly relevant and important.

On the contrary, pro-environmental behaviour refers to actions that minimise negative impacts on the natural world or even have a positive impact on the environment.¹⁶ Steg and Vlek¹⁷ explain that this behaviour is influenced by internal motivations (values and attitudes) as well as external barriers (costs and infrastructure). Some fundamental theories in this field include the Value-Belief-Norm (VBN) Theory, which emphasises personal values that activate the normative obligation to act.¹⁸ Norm Activation Model (NAM): Focuses on how personal norms serve as the primary driver of helping behaviour, including helping the environment.¹⁹ Theory of Planned Behaviour (TPB): Emphasises rational consideration and control over behaviour.²⁰ The Theory of Planned Behaviour (TPB), developed by Icek Ajzen²¹, extends the Theory of Reasoned Action (TRA) previously proposed by Fishbein and Ajzen.²² TPB adds a crucial construct, Perceived Behavioural Control (PBC), not present in TRA, to accommodate the fact that not all behaviour is entirely under the individual's control. Within the TPB framework, behaviour is a direct result of behavioural intention, which, in turn, is shaped by three primary antecedents.

First, Attitude Toward Behaviour is defined as the extent to which an individual holds a favourable or unfavourable evaluation of a particular behaviour. This attitude is based on salient beliefs regarding the possible consequences of that behaviour, multiplied by the individual's assessment of those outcomes. In the context of waste management, individuals who believe that sorting waste will have a positive impact on the environment and consider this impact important will form a more positive attitude

People Act Environmentally and What Are the Barriers to pro-Environmental Behavior?," *Environmental Education Research* 8, no. 3 (2002): 239–60.

¹⁶ Kollmuss and Agyeman, "Mind the Gap: Why Do People Act Environmentally and What Are the Barriers to pro-Environmental Behavior?"

¹⁷ Linda Steg and Charles Vlek, "Encouraging Pro-Environmental Behaviour: An Integrative Review and Research Agenda," *Journal of Environmental Psychology* 29, no. 3 (2009): 309–17.

¹⁸ Paul C. Stern, "New Environmental Theories: Toward a Coherent Theory of Environmentally Significant Behavior," *Journal of Social Issues* 56, no. 3 (2000): 407–24.

¹⁹ Shalom Schwartz, "Normative Influences on Altruism," in *Advances in Experimental Social Psychology*, vol. 10, ed. Leonard Berkowitz (Academic Press, 1977), [https://doi.org/10.1016/S0065-2601\(08\)60358-5](https://doi.org/10.1016/S0065-2601(08)60358-5).

²⁰ Ajzen, "The Theory of Planned Behavior."

²¹ Ajzen, "The Theory of Planned Behavior."

²² Martin Fishbein and Icek Ajzen, *Belief, Attitude, Intention, and Behavior: An Introduction to Theory and Research* (Addison-Wesley Publishing Company, 1975).

toward sorting waste.²³ Second, Subjective Norm refers to an individual's belief regarding whether people who are important and influential to them, such as family, friends, and colleagues, approve or disapprove of the behaviour. Subjective norms are shaped by normative beliefs interacting with the motivation to comply with the expectations of others. In the collectivist cultures dominant in East and Southeast Asia, social pressure from reference groups often plays a more dominant role in determining behaviour than personal preferences and evaluations.²⁴

Third, Perceived Behavioural Control (PBC) refers to an individual's perception of the ease or difficulty of performing a specific behaviour. PBC has two components: control beliefs, which are beliefs about the existence of factors that can facilitate or hinder behaviour; and perceived power, which is the perceived impact of those factors on the ability to behave. PBC can influence behaviour directly, independent of its influence on intention, when actual conditions align with perceived conditions.²⁵ The implications for waste management are clear: even if an individual's attitudes are supportive and norms are in place, the lack of segregated waste bins or adequate waste collection services will reduce PBC and ultimately diminish both intention and actual behaviour. Fourth, Behavioural Intention (behavioural intention) is a mediating variable that captures the motivational factors influencing behaviour. Intention indicates how strongly and how committed a person is to attempt a specific action. Intention is the best available indicator for predicting specific behaviours performed by individuals in conditions where those behaviours are under high volitional control. The stronger the intention, the greater the likelihood that the behaviour will be carried out.²⁶

Contemporary research indicates that the standard TPB model can explain only approximately 40–50% of the variance in environmental behavioural intentions; consequently, researchers consistently recommend incorporating additional contextual variables to enhance the model's predictive power.²⁷ Some of the most frequently tested additional variables in the context of environmental behaviour are, first, Environmental Awareness: Factual knowledge about environmental issues, their causes, and their consequences. This variable serves as a cognitive precursor that lays the groundwork for

²³ Ajzen, "The Theory of Planned Behavior"; Mei-Fang Chen and Pei-Ju Tung, "The Moderating Effect of Perceived Lack of Facilities on Consumers' Recycling Intentions," *Environment and Behavior* 42, no. 6 (2010): 824–44.

²⁴ Ricky Y. K. Chan and Loretta B. Y. Lau, "Antecedents of Green Purchases: A Survey in China," *Journal of Consumer Marketing* 17, no. 4 (2000): 338–57; Nguyen et al., "Community-Based Environmental Attitudes and Waste Management Behaviour."

²⁵ Icek Ajzen, "Perceived Behavioral Control, Self-Efficacy, Locus of Control, and the Theory of Planned Behavior," *Journal of Applied Social Psychology* 32, no. 4 (2002): 665–83, <https://doi.org/10.1111/j.1559-1816.2002.tb00236.x>; Robert Gifford and Andreas Nilsson, "Personal and Social Factors That Influence Pro-Environmental Concern and Behaviour: A Review," *International Journal of Psychology: Journal International De Psychologie* 49, no. 3 (2014): 141–57.

²⁶ Ajzen, "The Theory of Planned Behavior."

²⁷ C. J. Armitage and M. Conner, "Efficacy of the Theory of Planned Behaviour: A Meta-Analytic Review," *The British Journal of Social Psychology* 40, no. 4 (2001): 471–99, <https://doi.org/10.1348/014466601164939>.

the formation of more accurate and robust attitudes.²⁸ Without a basic awareness of the impacts of waste, individuals will lack the cognitive foundation necessary to form meaningful attitude evaluations.

Second, Moral Obligation: A sense of personal responsibility to act in an ethically correct manner, independent of external social pressure. In Iran, this variable was found to be a stronger predictor than subjective norms, indicating that religious values and personal ethics play a significant role in shaping environmental behavioural intentions.²⁹ Moral obligation operates through personal norms that are automatically activated when individuals feel a responsibility to prevent environmental harm.

Third, Perceived Risk: Concerns about adverse health and environmental impacts resulting from inadequate waste management. In developing countries in Asia, perceived risk is often a primary emotional driver that heightens the urgency of pro-environmental attitudes.³⁰ Communities living near open dumps or directly experiencing flooding caused by clogged drainage channels tend to perceive a higher risk. Fourth, Environmental Identity: The extent to which an individual defines themselves as part of or connected to nature and the environment. A strong environmental identity reinforces consistency between attitudes and behaviour because pro-environmental actions become an expression of the individual's self-concept.³¹

Another essential debate concerns sustainable waste management: a system designed to minimise waste generation, maximise resource recovery, and minimise the environmental impact of final disposal.³² This paradigm shifts from the linear “collect-transport-dispose” approach toward a circular economy that emphasises resource efficiency through the 3R principles: Reduce, Reuse, and Recycle. The success of the transition to this paradigm heavily depends on source separation, which demands high levels of cognitive, affective, and conative participation from all segments of society.³³

From a public policy perspective, there are two main approaches to promoting sustainable waste management behaviour. The first approach is command-and-control, or mandatory regulation, which involves implementing rules and penalties requiring the public to sort waste or reduce plastic use. China is a leading example of mandatory waste sorting, which has been officially enforced in major cities since 2019. This approach is effective in rapidly changing behaviour, but it has weaknesses regarding long-term

²⁸ Hao-Chen Huang et al., “Environmental Consciousness and Green Customer Behavior: An Examination of Motivation Crowding Effect,” *International Journal of Hospitality Management* 40, no. 1 (2014): 139–49.

²⁹ Heidari et al., “Youth Motivations and Barriers to Plastic Waste Segregation Management. *International Journal of Sustainable.*”

³⁰ Rambalak Yadav and Govind Swaroop Pathak, “Intention to Purchase Organic Food among Young Consumers: Evidences from a Developing Nation,” *Appetite* 96, no. 1 (2016): 122–28.

³¹ Jan E. Stets and Chris F. Biga, “Bringing Identity Theory into Environmental Sociology,” *Sociological Theory* 21, no. 4 (2003): 398–423.

³² Anwar, M. N. et al., “Emerging Challenges in E-Waste and Its Management: A Review,” *Environmental Science and Pollution Research* 27 (2020): 1–20.

³³ Q. J. Zheng et al., “Correlation between Environmental Knowledge, Attitude, and Behavioural Intention,” *Applied Ecology and Environmental Research* 16, no. 1 (2018): 51–62.

sustainability because behavioural changes are compliance-driven (driven by external compliance) rather than internalised (driven by intrinsic motivation).³⁴

The second approach involves behavioural nudges and community-based interventions, which aim to alter the architecture of choice to facilitate pro-environmental choices without relying on penalties. Community-based interventions found to be effective in Vietnam demonstrate that when communities understand the direct link between environmental cleanliness and local economic sustainability, particularly in tourist areas, collective social norms form organically and reinforce intentions for more sustainable behaviour.³⁵

III. DYNAMICS OF WASTE MANAGEMENT IN FIVE ASIAN COUNTRIES

Vietnam faces significant pressure in waste management amid rapid economic growth and a tourism boom. Tourist areas such as Cu Lao Cham Island and Hoi An face serious challenges from plastic waste generated by both domestic and international tourists. However, several community-based intervention programs have successfully transformed local social norms, making environmental cleanliness a collective value upheld by the local community. A study by Nguyen et al.³⁶ shows that communities in this region have high environmental attitude scores because they directly experience the economic benefits of a clean and sustainable environment, creating a positive feedback loop between pro-environmental attitudes and economic well-being.

China, as the country with the largest population and economy in Asia, faces massive waste management challenges. The Chinese government has implemented a mandatory waste sorting system in major cities such as Shanghai and Beijing since 2019. This regulation is supported by a strict system of incentives and penalties, including fines for violators. Its implementation demonstrates that top-down regulations can accelerate behavioural change in a short period; however, a study by Wang et al.³⁷ indicates that long-term success depends heavily on the synchronisation of regulations, social norms, and adequate infrastructure support, particularly in rural areas and remote mountainous regions.

Indonesia faces a dual challenge in waste management: on the one hand, rapid consumption growth generates ever-increasing volumes of waste; on the other hand, waste management infrastructure remains inadequate, and the system for collecting sorted waste remains limited. An interesting paradox is evident in the Indonesian context: the public generally exhibits relatively high environmental awareness and pro-environmental attitudes, yet actual behaviour regarding waste sorting and management remains far from optimal. Dhokhikah et al.³⁸ explain that the limited availability of

³⁴ Wang et al., “Determinants of Household Waste Sorting Behaviour under Mandatory Policy in China.”

³⁵ Nguyen et al., “Community-Based Environmental Attitudes and Waste Management Behaviour.”

³⁶ Nguyen et al., “Community-Based Environmental Attitudes and Waste Management Behaviour.”

³⁷ Wang et al., “Determinants of Household Waste Sorting Behaviour under Mandatory Policy in China.”

³⁸ Yeny Dhokhikah et al., “Community Participation in Household Solid Waste Reduction in Surabaya, Indonesia,” *Resources, Conservation and Recycling* 102 (October 2015): 153–62.

separate waste collection services significantly reduces the public's PBC, creating a sense of frustration that ultimately erodes the motivation to behave in an environmentally friendly manner despite positive attitudes.

Interestingly, in Iran, moral obligation was found to be a stronger factor than subjective norm, indicating that religious values and personal ethics play a significant role.³⁹ Iran faces the challenge of rapid urbanisation, with a sharp increase in consumption among urban populations, while its waste management system has not yet kept pace. The most compelling finding from the Iranian context is the dominant role of moral obligation as a predictor of environmental behavioural intentions. Heidari et al.⁴⁰ found that the moral obligation factor, which, within the context of Iran's Muslim society, is heavily influenced by religious values regarding responsibility toward nature (*khalifatullah fil ardh*), exerts a stronger influence than pressure from subjective norms alone. This finding indicates that framing environmental issues in terms of religious values and personal ethics can be a highly effective communication strategy in countries with high religiosity.

While Japan is often held up as a global model for waste management, with high recycling rates and a highly detailed, complex waste-sorting system. This system is underpinned by the culture of *omotenashi* (hospitality and consideration for others) and a shame culture, in which violations of waste-sorting rules are viewed as socially embarrassing. Residents in Japan adhere to the sorting system not because of a "passionate commitment" to saving the Earth, but rather due to compliance with social norms that have been internalized over generations. Stanislawski et al.⁴¹ explain that this is why environmental attitude scores in questionnaire-based surveys in Japan tend to be lower, not due to a lack of concern, but because pro-environmental behaviour has become habitual behaviour that is no longer processed deliberately or explicitly.

IV. META-ANALYSIS AS A METHOD FOR SYNTHESISING MULTIPLE STUDIES

A meta-analysis is a quantitative research method that systematically collects, codes, and analyses statistical data from various individual studies addressing the same topic to produce more accurate and comprehensive effect estimates.⁴² Unlike narrative reviews, which rely on the researcher's subjective judgment, meta-analysis uses effect sizes as a universal unit of analysis, allowing equitable comparisons across studies that employ different measures, instruments, and contexts. In environmental research, the use of the Random-Effects model becomes crucial when the synthesised studies originate from

³⁹ Heidari et al., "Youth Motivations and Barriers to Plastic Waste Segregation Management. *International Journal of Sustainable*."

⁴⁰ Heidari et al., "Youth Motivations and Barriers to Plastic Waste Segregation Management. *International Journal of Sustainable*."

⁴¹ Stanislawski et al., "Household Waste Segregation Behaviour in Japan."

⁴² Michael Borenstein et al., "Introduction: How a Meta-Analysis Works," in *Introduction to Meta-Analysis* (John Wiley & Sons, Ltd, 2009), <https://doi.org/10.1002/9780470743386>.

populations that differ demographically, culturally, and contextually.⁴³ This model assumes that there is no single “true effect” that applies universally; rather, each study estimates an effect size from a broader population distribution. High heterogeneity, as measured by the I^2 statistic, in the Random-Effects model is valuable information indicating the presence of important moderator variables that need to be identified and analysed further.

This study employs a meta-analysis approach using a random-effects model and OpenMEE software as the analytical tool. The random-effects model was selected for the analysis because the data were drawn from populations across several countries with varying demographic characteristics. This method was chosen to synthesise statistical data (mean, standard deviation, sample size) from various primary studies published in multiple journals to draw more robust conclusions. This study employs a quantitative meta-analysis approach using a Continuous Random-Effects model. The Random-Effects model was specifically chosen because the data in this study originate from populations across five different countries with significantly varying demographic, cultural, infrastructure, and policy system characteristics. Between-study variation in this model is treated as a random component reflecting the true diversity of the population, rather than merely as sampling error.

The data were sourced from five eligible journal articles, including research studies, the theories employed, and the theoretical indicators used. The literature search was conducted in databases using several keywords, including “waste management,” “attitude,” “Theory of Planned Behaviour (TPB),” and “Asia.” The established inclusion criteria include: (1) quantitative studies that use the Theory of Planned Behaviour framework or at least include the variables of attitude, subjective norm, PBC, and/or behavioural intention in the context of waste management or pro-environmental behaviour; (2) studies with sufficient statistical data for effect size extraction, including correlation coefficients (r), or mean and standard deviation values that can be used to calculate Cohen’s d ; (3) studies located in the Asian region; and (4) studies published between 2010 and 2026 to ensure contextual relevance. Exclusion criteria included purely qualitative studies, non-systematic reviews, or those that lacked adequate statistical data for quantitative synthesis. Based on this systematic selection process, five primary studies were selected that met all inclusion criteria, including:

1. Study 1: Nguyen et al.⁴⁴ on community-based waste management in tourist areas in Vietnam
2. Study 2: Wang et al.⁴⁵ on determinants of household waste sorting behaviour in China
3. Study 3: Widayat et al.⁴⁶ on pro-environmental attitudes and recycling intentions in Indonesia

⁴³ Bamberg and Möser, “Twenty Years after Hines, Hungerford, and Tomera: A New Meta-Analysis of Psycho-Social Determinants of pro-Environmental Behaviour.”

⁴⁴ Nguyen et al., “Community-Based Environmental Attitudes and Waste Management Behaviour.”

⁴⁵ Wang et al., “Determinants of Household Waste Sorting Behaviour under Mandatory Policy in China.”

⁴⁶ Widayat et al., “Pro-Environmental Attitude and Recycling Intention in Indonesia.”

4. Study 4: Stanislawski et al.⁴⁷ on waste management behaviour and social norms in Japan
5. Study 5: Heidari et al.⁴⁸ on moral obligations and intentions regarding household waste sorting in Iran

The data extracted from each study included: study details (authors, year, country), sample size (N), the type of variable relationship tested (some variable such as attitude variable to intention variable, PBC variable to intention variable, intention variable to behaviour variable, correlation coefficients (r) along with their variances (Vr), as well as means (M) and standard deviations (SD) for comparative analysis. Any discrepancies between the two extractions were resolved through consensus discussions. Data from the 5 articles were extracted into CSV format, including the mean (average) attitude, the standard deviation (SD), and the sample sizes for the treatment and control groups. The control group in this case is the reference or benchmark country, namely Vietnam, and the treatment group consists of the countries to be compared with the reference, namely the other four countries (Table 1). Table 2 presents the specific dataset for this study.

Table 1. Statistical Data for the Meta-Analysis

Study ID	Year	Country	Association	N	r	Vr
Nguyen_Vietnam	2026	Vietnam	Attitude→Intention	300	0.130	0.003232
Wang_China	2025	China	Attitude→Intention	216	0.269	0.004002
Widayat_Indonesia	2022	Indonesia	Attitude→Intention	200	0.510	0.002731
Heidari_Iran	2018	Iran	Attitude→Intention	420	0.210	0.002165
Nguyen_Vietnam	2026	Vietnam	PBC→Intention	300	0.390	0.002400
Wang_China	2025	China	PBC→Intention	216	0.064	0.004600
Widayat_Indonesia	2022	Indonesia	PBC→Intention	200	0.420	0.003400
Heidari_Iran	2018	Iran	PBC→Intention	420	0.480	0.001400
Nguyen_Vietnam	2026	Vietnam	Intention→Behaviour	300	0.560	0.001500
Wang_China	2025	China	Intention→Behaviour	216	0.209	0.004200
Widayat_Indonesia	2022	Indonesia	Intention→Behaviour	200	0.610	0.001900
Heidari_Iran	2018	Iran	Intention→Behaviour	420	0.570	0.001100

Table 2. Specific Statistical Data for a Comparative Study of Attitudes Toward Waste

⁴⁷ Stanislawski et al., "Household Waste Segregation Behaviour in Japan."

⁴⁸ Heidari et al., "Youth Motivations and Barriers to Plastic Waste Segregation Management. International Journal of Sustainable."

Management

Comparison	N Viet	M Viet	SD Viet	N Opponents	M Opponent	SD Lawan	Label
Vietnam vs China	198	4.71	0.55	272	4.21	0.78	China
Vietnam vs Indonesia	198	4.71	0.55	150	4.15	0.75	Indonesia
Vietnam vs Iran	198	4.72	0.56	420	4.30	0.57	Iran
Vietnam vs Japan	198	4.72	0.56	757	3.31	0.75	Japan

All data analysis was conducted using the OpenMEE (Open Meta-Analyst for Ecology and Evolution) software through a series of systematic steps. The first step involved putting the extracted statistical data into an OpenMEE worksheet, where the Study ID variable was coded as a 'count' and the quantitative variables (N, r, Vr, Mean, SD) were coded as 'continuous'. The second step was configuring the estimation model. For the standard meta-analysis of TPB variables, correlation data (r) were converted to Fisher's Z (Zr) to meet the assumption of normality before being processed in a Random-Effects model. Fisher's Z transformation was used because the distribution of correlation coefficients is not normal, particularly at high r values. For the comparative analysis of attitudes, Cohen's d (Standardised Mean Difference) was used with Vietnam as the reference group (baseline).

The third step involves the computational process that generates a forest plot—a graphical visualization displaying the individual effect estimates from each study along with their 95% confidence intervals, as well as a diamond at the bottom representing the pooled effect size. In addition to the standard forest plot, a cumulative forest plot is also generated, showing how the pooled effect size changes as studies are cumulatively added. The fourth stage is the evaluation of heterogeneity using three main parameters: (a) the Q statistic (Cochran's Q test), which tests whether the variability in effect sizes exceeds what would be expected from sampling error alone; (b) the I² value (Higgins' I-squared statistic), which quantifies the proportion of total variability in effect sizes attributable to true heterogeneity among studies; and (c) the tau² value (tau-squared), which is an estimate of the variance of the true effect size distribution in a Random-Effects model. An I² value above 75% is classified as high heterogeneity, which, in the context of this cross-national study, is anticipated and actually serves as substantive information that enriches the interpretation.

Based on the results of the meta-analysis, statistical decisions will be made using a significance test of the combined effect to test H₀. The first stage aims to test H₀ (There is no significant difference in the mean environmental attitude scores across countries).

The test is conducted by examining the Z-value and p-value of the overall effect estimate. The second stage aims to test H1 (There is a significant and systematic difference in the mean scores). Since the meta-analysis combines studies from diverse populations (Vietnam, China, Indonesia, Iran, Japan), testing H1 is based not only on the mean but also on the presence of heterogeneity. The third stage involves a specific test for H1a (People in developing countries have higher attitude scores compared to those in developed countries). This test is conducted using descriptive comparative analysis by examining the position of the Point Estimate on the Forest Plot.

Based on data analysis using OpenMEE, 15 studies examine relationships among variables in the Theory of Planned Behaviour (Attitude, PBC, and Intention) across five Asian countries: Vietnam, China, Indonesia, Iran, and Japan. The results of the analysis using the Random Effects model reveal a significant positive correlation between pro-environmental variables and intention/behaviour. The population in the Asian region is estimated at 0.348. This result is statistically significant because the p-value is < 0.001 , using a 95% confidence interval ranging from 0.263 to 0.434. The level of heterogeneity indicates very high variability across studies, with an I value reaching 98.27%. The wide distribution of estimated points from left to right indicates high data heterogeneity; meanwhile, the graph on the right side of the vertical line represents a moderate combined positive effect (Figure 1).

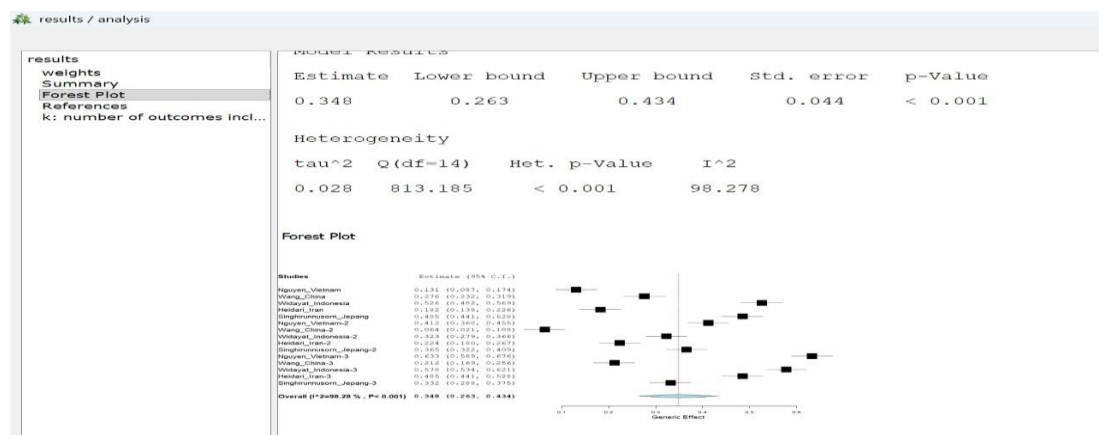


Figure 1. Forest plot from the meta-analysis

This study uses a cumulative forest plot, which differs from the standard forest plot that displays results for each study separately. The analysis shows differences in the impact of the study's findings due to different approaches. Based on the study results, the left figure, which is a standard forest plot, presents the results of the studies separately (individually), while the figure on the right shows that the first row describes the results of the study from Vietnam, the second row adds the study related to China, and the third row presents a combined calculation of the studies, including the study in Indonesia up to the final study (Figure 2).



Figure 2. Cumulative forest plot meta-analysis

Based on Figure 2, there is information that can be explained. The first point concerns increased precision (shorter lines), indicating that uncertainty remains high and is driven by the relatively small amount of data. As we move down the figure, the lines become shorter. The inclusion of new studies from various countries (Vietnam, China, Indonesia) consistently improves the precision of the estimates. Additionally, the position of the black box shows fluctuations at the beginning, but after the 4th and 5th rows it stabilises around the midline (0.34–0.35). Overall, all the study results are consistent in showing that pro-environmental attitudes have a positive impact on waste management across Asia.

V. COMPARATIVE ANALYSIS OF ATTITUDES TOWARD WASTE MANAGEMENT

Results of the data tabulation for a comparative analysis using Cohen's *d* (Standardised Mean Difference). In this model, Vietnam is used as the control group or baseline against which the other four countries—China, Indonesia, Iran, and Japan—are compared. The input data structure consists of continuous data, differing from the previous data set, which used correlation values. This analysis uses the mean and standard deviation (SD). The reference group (Vietnam) shows a consistently high mean attitude score of 4.71–4.72 with a standard deviation of 0.55. Meanwhile, the comparison group shows average scores for other countries ranging from 3.31 (Japan) to 4.30 (Iran). In the yellow column, positive *d*-values across all rows indicate that Vietnam's average score is higher than those of all other countries. Additionally, there is a significant gap between Vietnam and Japan (SD value of 1.97), Vietnam and Indonesia (SD value of 0.86), and Vietnam and China and Iran (SD values ranging from 0.72 to 0.74). Overall, Vietnam has the highest Environmental Attitude score among Asian countries.

The results of the analysis using a Forest Plot with a Continuous Random Effects model and the Standardised Mean Difference (Cohen's *d*) metric (Figure 3). This analysis

aims to compare the extent of differences in environmental attitude scores between Vietnam and four other countries: China, Indonesia, Iran, and Japan. On average, environmental attitude scores in Vietnam were significantly higher than those in the other comparison countries, with an effect size of 1.076. This indicates a large effect and a striking and substantial difference. In terms of statistical significance, the resulting p-value is < 0.001 , which is far below 0.05. Based on this, the null hypothesis is rejected, and it is proven that the population in Vietnam in this study exhibits a higher pro-environmental attitude compared to the comparison countries.

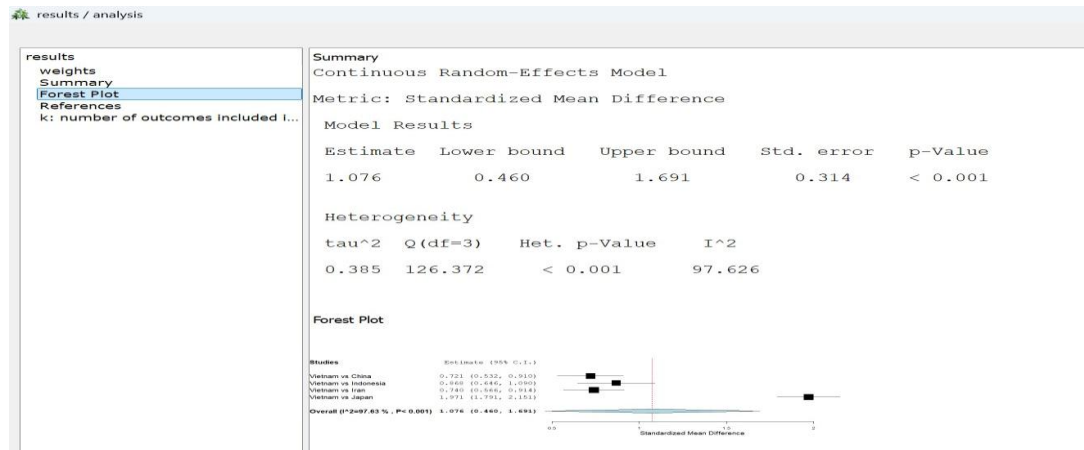


Figure 3. Forest plot from the meta-analysis

In terms of heterogeneity, the degree of variation in results across studies is very high, reaching 98%, and also indicates that Vietnam's scores relative to other countries are not consistent. This may also be due to the large gap in values between Vietnam and Japan, resulting in extreme data variation. As seen in the forest plot visualisation, the black points (point estimates) are positioned to the right of the red vertical line. This illustrates the data's consistency, showing that in every head-to-head comparison (with China, Indonesia, Iran, or Japan), Vietnam's scores are consistently higher. Meanwhile, the pencil, which represents the fourth comparison (the bottom row before the diamond), appears to be very far to the right. This is the comparison between Vietnam and Japan. This visualisation confirms the previous finding that the largest attitude gap occurs between Vietnam (high score) and Japan (low score in the context of explicit attitude).

A. Relationships Among TPB Variables

A standard meta-analysis was conducted to examine the strength of relationships among variables within the Theory of Planned Behaviour framework, linking attitude and intention, PBC and intention, and intention and behaviour in the context of waste management in Asia. Data from 13 pairs of variable relationships extracted from four studies (Vietnam, China, Indonesia, and Iran) were analysed simultaneously using a Random-Effects model with Fisher's Z conversion. The results of the standard meta-

analysis were highly statistically significant. The combined effect estimate showed a weighted average correlation coefficient of $r = 0.348$ (after back-conversion from Fisher's Z). This result was statistically significant (p -value < 0.001) with a 95% confidence interval ranging from 0.263 to 0.434. According to Cohen's⁴⁹ convention, a value of $r = 0.348$ falls into the moderate-to-large range, indicating that, on average, there is a moderate yet meaningful positive relationship between TPB variables and waste management behaviour in the Asian region. The resulting level of heterogeneity is very high, with an I^2 value of 98.27%. This means that 98.27% of the total variability in the estimated effects across studies is due to true heterogeneity (substantive differences between studies) rather than sampling error. This very high I^2 value confirms that there is no single "true effect" that applies universally across all country contexts and the pairs of variables studied; rather, the strength of the relationships among TPB variables varies substantially across country contexts.

Table 3. Summary of Effect Size Analysis Results by TPB Variable Pair

TPB Variables	Vietnam (r)	China (r)	Indonesia (r)	Iran (r)	Dominant Patterns
Attitude toward Intention	0.130	0.269	0.510	0.210	Indonesia (r=0.51)
PBC on Intention	0.390	0.064	0.420	0.480	Iran (r=0.48)
Intention toward Behaviour	0.560	0.209	0.610	0.570	Indonesia (r=0.61)

The most striking finding of this meta-analysis is the enormous variation in the strength of the relationships between variables across different countries. Regarding the relationship between the attitude and intention variables, Indonesia showed the highest correlation ($r = 0.510$), far exceeding those of Vietnam ($r = 0.130$), Iran ($r = 0.210$), and China ($r = 0.269$). This indicates that, in Indonesia, attitudes toward pro-environmental behaviour have very strong predictive power for intentions, suggesting that the direct pressure of waste-related issues in daily life may drive people to adopt attitudes deeply rooted in a genuine intent to change. Conversely, Vietnam showed the weakest correlation between the attitude and intention variables ($r = 0.130$). This paradox can be explained by the hypothesis that in Vietnam, particularly within the tourism communities sampled in Nguyen et al.⁵⁰, pro-environmental behaviour is driven more by social norms and collective economic incentives than by conscious, deliberative

⁴⁹ Jacob Cohen, *Statistical Power Analysis for the Behavioural Sciences (2nd Ed.)* (Lawrence Erlbaum Associates, 1988).

⁵⁰ Nguyen et al., "Community-Based Environmental Attitudes and Waste Management Behaviour."

individual attitude evaluations. This is consistent with the theory that in highly cohesive communities, subjective norms can take over the role of attitudes as the primary predictor of intention.

Regarding the relationship between the PBC and intention variables, Iran showed the highest correlation ($r = 0.480$), followed by Indonesia ($r = 0.420$) and Vietnam ($r = 0.390$), while China showed a nearly insignificant correlation ($r = 0.064$). The low correlation between the PBC variable and the intention variable in China can be interpreted as an effect of mandatory waste sorting regulations; that is, when behaviour is legally mandated, perceptions of control over behaviour become less relevant as a predictor of intention because intention itself is shaped more by compliance with regulations than by self-efficacy evaluations. Regarding the relationship between the intention variable and the behaviour variable, Indonesia and Iran showed the highest correlations ($r = 0.610$ and $r = 0.570$, respectively), indicating that in these two countries, when an individual already possesses a strong intention to engage in pro-environmental behaviour, that intention tends to manifest in concrete actions. This finding is particularly significant in a policy context, where interventions that successfully foster strong intentions will yield higher behavioural conversion rates in Indonesia and Iran compared to China.

The cumulative forest plot analysis provides valuable additional insight into the stability and convergence of effect estimates as evidence from various studies accumulates. When studies are added cumulatively in chronological order (Vietnam, then China, followed by Indonesia, and finally Iran), it is evident that the effect estimates exhibit significant fluctuations at the beginning of the accumulation (the first three studies), but begin to show increasingly clear stabilisation with the addition of the fourth and fifth studies. The widening of the confidence intervals in the early stages reflects high uncertainty when the data are still limited. However, the consistent position of the black box (point estimate) on the right side of the vertical zero line throughout the entire cumulative process confirms that the direction of the relationship—namely, the positive correlation between the TPB variable and waste management behaviour—is robust and remains unchanged by the addition of new studies. The stable final estimate of 0.34–0.35 provides high confidence in the reliability of this meta-analysis's conclusions.

The comparative analysis was conducted using Cohen's d (Standardised Mean Difference) with a Continuous Random-Effects model. Vietnam was designated as the reference group (baseline) because it had the highest mean environmental attitude score in the dataset ($M = 4.71$ – 4.72 , $SD = 0.55$ – 0.56). The comparison was conducted on a head-to-head basis between Vietnam and each of the other four countries (Table 4).

Table 4. Results of the Comparative Effect Size Analysis of Environmental Attitude

Comparison	Cohen's d	Interpretation	p-value	95% CI	Conclusion
Vietnam vs. China	0.721	Large	< 0.001	[0.55, 0.89]	Significant
Vietnam vs Indonesia	0.868	Large	< 0.001	[0.67, 1.07]	Significant
Vietnam vs Iran	0.740	Large	< 0.001	[0.58, 0.90]	Significant
Vietnam vs Japan	1.971	Very High	< 0.001	[1.74, 2.20]	Significant
Overall Pooled	1.076	Large	< 0.001	[0.89, 1.26]	Significant

The analysis indicates that the difference in environmental attitude scores between Vietnam and all comparison countries is statistically significant, with p-values < 0.001 in all comparisons. The overall pooled effect estimate of $d = 1.076$ falls into the large effect category according to Cohen's⁵¹ convention, indicating that, on average, environmental attitude scores in Vietnam are substantially higher than those in the comparison countries as a whole. The greatest disparity was observed between Vietnam and Japan, with a Cohen's d of 1.971. This value falls into the very large effect category. It indicates that the average environmental attitude score of the Vietnamese population ($M = 4.72$) differs by nearly 2 standard deviations from that of the Japanese population ($M = 3.31$). This very large gap is the most significant and, simultaneously, the most intriguing finding in this study, as it intuitively contrasts with the fact that Japan has a far more advanced and efficient waste management system than Vietnam. Comparisons of Vietnam with other developing countries reveal a more moderate yet still significant pattern: Vietnam vs Indonesia ($d = 0.868$), Vietnam vs Iran ($d = 0.740$), and Vietnam vs China ($d = 0.721$). All of these d values fall into the large effect category ($d > 0.8$ for Indonesia; $d > 0.5$ for Iran and China), indicating that although they are all developing or emerging economies, there are substantial differences in the intensity of pro-environmental attitudes between countries.

⁵¹ Cohen, *Statistical Power Analysis for the Behavioural Sciences (2nd Ed.)*.

VI. CROSS-NATIONAL DIFFERENCES IN PSYCHOSOCIAL MECHANISMS THROUGH THE LENS OF THE THEORY OF PLANNED BEHAVIOUR

A comparative analysis of psychosocial differences between countries shows that Vietnam has a relatively much weaker waste management infrastructure than Japan, yet scores much higher on environmental attitudes. The TPB analytical framework explains that TPB is not a universal theory that operates identically across all cultural contexts. Ajzen⁵² himself acknowledges that the salient beliefs shaping attitudes, norms, and perceived control are culture-specific and context-bound. Consequently, the differences in environmental attitude scores found in this study do not merely reflect differences in the “level of environmental concern,” but rather fundamental differences in how TPB constructs are activated, processed, and expressed within each socio-cultural system. This section provides an in-depth explanation of how the four main constructs, namely, the TPB variables of attitude, subjective norm, perceived behavioural control, and behavioural intention, operate differently across the five study countries.

Within the TPB framework, attitude toward behaviour is shaped by salient behavioural beliefs, that is, an individual’s beliefs about the likely consequences of a behaviour, multiplied by an evaluation of those consequences.⁵³ This construct is deliberative, meaning it is activated when an individual consciously engages in cognitive assessment and affective evaluation of a behaviour. This understanding is key to explaining the paradox in attitude scores between developing countries and Japan. In Vietnam, Indonesia, and Iran, the behavioural beliefs that shape attitudes toward waste management are continuously reinforced through a wide range of highly intense environmental stimuli. People who witness rivers filled with plastic waste, streets flooded due to clogged drainage systems, or air polluted by open-air waste burning daily. This fosters a very strong belief in the negative consequences of poor waste management. Indirectly, these conditions create an attitude of a reactive-affective nature. Reactive-affective traits are attitudes formed as emotional responses to threatening environmental stimuli. When a person is later asked to complete a questionnaire, this emotional response is readily articulated in high scores.⁵⁴ Ajzen himself acknowledges that the affective component of attitude, that is, the emotional feelings associated with behaviour, can significantly strengthen the expression of attitude when relevant stimuli are highly salient in an individual’s environment.

This contrasts with the findings of a study conducted in Japan. After several decades of a strict and consistent waste management system, waste sorting behaviour in Japan is no longer processed through the TPB’s deliberative pathway (starting with the beliefs stage, then attitude, followed by intention, and ending with behavioural change), but has shifted into habitual behaviour and automatic actions performed without

⁵² Ajzen, “The Theory of Planned Behavior.”

⁵³ Ajzen, “The Theory of Planned Behavior.”

⁵⁴ Kollmuss and Agyeman, “Mind the Gap: Why Do People Act Environmentally and What Are the Barriers to pro-Environmental Behavior?”

conscious cognitive evaluation.⁵⁵ Once a behaviour has become an automatic habit, it no longer requires mediation through the deliberative construct of attitude. Consequently, when Japanese citizens are asked to complete a questionnaire measuring their explicit evaluation of the importance of waste sorting, the question no longer holds strong motivational relevance because the behaviour is already performed automatically, not due to conscious consideration. This explains why Japanese people's explicit attitude scores are lower: not because they care less, but because their concern has moved beyond the deliberative stage and into a much deeper stage of internalisation. This highlights a significant implication for analysis using the TPB approach and theory. Essentially, the TPB analytical approach is crucial for examining behavioural changes that are still in the deliberative phase or have not yet become habits. However, once such behaviour has been internalised as a habit, as is the case in Japan, the TPB model cannot be applied, particularly for predicting behavioural change.⁵⁶

In the TPB, the subjective norm is defined as an individual's perception of social pressure from important reference groups regarding whether they approve or disapprove of a particular behaviour. This construct is highly sensitive to cultural context because 'who is considered important,' 'how much group pressure is internalised,' and 'how social norms are communicated' vary greatly across cultures.⁵⁷ In Vietnam, particularly within the tourism community sampled in Nguyen et al.'s⁵⁸ study, the subjective norm operates through a very tangible, concrete mechanism of collective interest. When all community members realise that a clean environment is an absolute prerequisite for the sustainability of tourism, their primary source of livelihood, social norms supporting pro-environmental behaviour form organically and strongly. Social pressure here is not abstract, and it starts with "we must protect the environment for future generations", but rather highly pragmatic and direct, as is said with "if the environment is dirty, tourists won't come and we won't be able to survive" This type of social norm, rooted in shared economic interests, generates a very strong subjective norm that directly contributes to high levels of attitude and strong intentions.

In China, subjective norms operate in a unique context: mandatory waste sorting regulations have effectively created a top-down norm through government authorities. Wang et al.⁵⁹ found that in China, normative pressure from the government and from already compliant local communities both contribute to the formation of behavioural intentions. Interestingly, descriptive norms, that is, what others actually do, play a

⁵⁵ Judith A. Ouellette and Wendy Wood, "Habit and Intention in Everyday Life: The Multiple Processes by Which Past Behavior Predicts Future Behavior," *Psychological Bulletin* (US) 124, no. 1 (1998): 54–74; B. Verplanken and H. A. G. Aarts, "Habit, Attitude, and Planned Behaviour : Is Habit an Empty Construct or an Interesting Case of Goal-Directed Automaticity?," *European Review of Social Psychology* 10, no. 1 (1999): 101–34.

⁵⁶ Bas Verplanken and Sheina Orbell, "Reflections on Past Behavior: A Self-Report Index of Habit Strength," *Journal of Applied Social Psychology* 33, no. 6 (2003): 1313–30.

⁵⁷ Harry C. Triandis, *Individualism And Collectivism* (Westview Press, 1995); Chan and Lau, "Antecedents of Green Purchases: A Survey in China."

⁵⁸ Nguyen et al., "Community-Based Environmental Attitudes and Waste Management Behaviour."

⁵⁹ Wang et al., "Determinants of Household Waste Sorting Behaviour under Mandatory Policy in China."

significant role. In China, waste-sorting behaviour in major cities is deeply ingrained because it has become a visually evident, everyday norm. When someone sees neighbours and coworkers consistently sorting waste, the normative pressure to do the same is very high. However, the main weakness of this system is that the subjective norm that forms stems more from compliance with external authority than from the internalisation of values; thus, when supervision decreases (for example, in remote rural areas), behavioural compliance also tends to decline.

In Indonesia, the subjective norm faces unique challenges related to social fragmentation. At the level of cohesive local communities, such as PKK (Family Welfare Empowerment) groups or waste bank communities, subjective norms can be very strong. However, in more anonymous and heterogeneous urban environments, normative pressure weakens significantly. Dhokhikah et al.⁶⁰ found that the absence or weakness of infrastructure also indirectly weakens these subjective norms. When no separate waste collection points are available, the norm of sorting waste becomes practically irrelevant, and over time, the social norms supporting it also weaken. This creates a situation where individual attitudes may be very positive, yet the social norms that should reinforce them do not operate effectively due to infrastructure barriers.

In Iran, subjective norms operate through two synergistic channels: the religious channel and the community channel. Islamic values regarding human responsibility as *khalifatullah fil ardh* (stewards of the earth responsible for nature) create strong religious normative pressure, in which environmentally responsible behaviour is viewed as a religious duty. Heidari et al.⁶¹ found that in the Iranian context, moral formation based on ethical standards heavily influenced by religious norms is actually stronger than subjective norms in the conventional social sense. This suggests that in highly religious societies, the primary reference group can be “God” or the “faith community,” not just family and friends. Theoretically, this finding expands the concept of subjective norm in TPB to include a transcendental dimension that has rarely been elaborated upon in Western literature.

In Japan, subjective norms operate through the most complex and unique mechanisms among all the countries studied. A key finding here relates to the deep-seated shame culture in Japanese society, which creates a normative pressure that is both omnipresent and self-reinforcing. Unlike guilt culture, where one feels guilty for violating internal values, shame culture operates through feelings of shame triggered by the perceived judgment of others. Consequently, in Japan, violating waste-sorting rules is not merely an act considered “wrong,” but also a socially shameful act that can damage one’s reputation within the community. This mechanism generates extremely high behavioural compliance through the subjective norm pathway, even in the absence of strong explicit attitudes. In TPB terminology, this means that the subjective norm exerts a direct influence on attitude formation as the primary antecedent that generates

⁶⁰ Dhokhikah et al., “Community Participation in Household Solid Waste Reduction in Surabaya, Indonesia.”

⁶¹ Heidari et al., “Youth Motivations and Barriers to Plastic Waste Segregation Management. *International Journal of Sustainable.*”

intention, a pattern consistently found to be more prevalent in East Asian collectivist cultures.⁶²

A. Perceived Behavioural Control: The Gap Between Infrastructure and Psychological Capacity

Perceived Behavioural Control (PBC) in the TPB refers to an individual's perception of how easy or difficult it is to perform a behaviour, influenced by internal factors (e.g., self-efficacy and skills) and external factors (e.g., availability of facilities, social support, and regulations). PBC not only influences intention but can also directly affect behaviour when perceived conditions reflect actual conditions.⁶³ This variable exhibits the greatest variation across the five study countries because it is highly dependent on the quality of physical infrastructure and institutional waste management systems. Based on data from the meta-analysis, a particularly striking finding is that the correlation between the PBC variable and the intention variable in China is only $r = 0.064$ —meaning it is nearly insignificant in substantive terms—when compared to Iran ($r = 0.480$), Indonesia ($r = 0.420$), and Vietnam ($r = 0.390$). Theoretically, this result can be explained by a phenomenon known as the “regulatory displacement of volitional control.” When regulations are mandated for waste sorting and strictly enforced in China, behavioural compliance no longer depends on individuals' evaluations of their ability and ease of sorting waste (low or high PBC yields the same behaviour because of the legal obligation). In other words, mandatory regulations effectively eliminate the mediating role of PBC in the TPB chain because behaviour is no longer voluntary (entirely based on an individual's free will), but rather legally obligated.

In Indonesia, waste separation is the most critical and problematic issue. Indonesians generally hold positive pro-environmental attitudes, yet their waste separation rates are often very low due to significant infrastructure limitations. The lack of facilities for sorted waste disposal, the absence of a regular waste collection schedule, and uncertainty regarding what happens to sorted waste (whether it is actually recycled or mixed back together by collection crews) result in low perceived behavioural control. In TPB terminology, this is a concrete manifestation of barriers to factual control beliefs, not merely perceptions. This low PBC then contributes to a significant attitude-behaviour gap: an individual may hold a very positive attitude ($M = 4.15$), yet their intention is not as high as their attitude because, realistically, they feel they lack sufficient control to carry out the desired behaviour. This finding is consistent with Bandura's⁶⁴ argument that low self-efficacy, as a key component of PBC, directly weakens the motivation to act even when the desire and intention are already present.

⁶² Ajzen, “The Theory of Planned Behavior”; Triandis, *Individualism And Collectivism*.

⁶³ Ajzen, “The Theory of Planned Behavior.”

⁶⁴ Albert Bandura, *Self-Efficacy: The Exercise of Control* (W. H. Freeman and Company, 1997).

In Vietnam (within the context of the tourism community), PBC operates differently and in a more conducive manner. The community-based intervention variables reported by Nguyen et al.⁶⁵ not only changed social norms but also simultaneously improved PBC by providing facilities (adequate trash bins, clear sorting instructions) and capacity-building training (education on proper sorting methods). When infrastructure and knowledge are available simultaneously, PBC increases significantly, which in turn drives stronger intentions and behaviours. This suggests that the most effective interventions for improving PBC are those that simultaneously target internal factors (self-efficacy, knowledge) and external factors (facilities, access, information systems). In Japan, PBC is worth analysing from a different perspective. Objectively, the Japanese public's PBC is very high because waste management infrastructure is highly adequate, and clear sorting systems are available in every household. However, PBC in Japan has transcended its role as an antecedent of intention in the standard TPB model. Once behaviour has become automated, PBC no longer needs to be consciously evaluated every time a person is about to sort waste. Behaviour is carried out automatically through established routines, not through constant re-evaluation of ability and convenience. This once again explains why the standard TPB model has limitations in predicting behaviour that has been internalised as a habit in countries with mature waste management systems.

B. Behavioural Intention: The Conversion of Intention into Behaviour and the Role of Mediating Factors

Behavioural intention is a central construct in the TPB that serves as a mediator between psychological antecedents (attitudes, norms, PBC) and actual behaviour. The strength of the relationship between the intention variable and the behaviour variable in this meta-analysis shows highly informative variations, as evidenced by the results from Indonesia, which had the highest correlation ($r = 0.610$), followed by Iran ($r = 0.570$), Vietnam ($r = 0.560$), and China ($r = 0.209$). The low correlation between the intention and behaviour variables in China ($r = 0.209$) is a theoretically significant finding. This indicates that in China, there is a relatively large discrepancy between the intentions reported in the survey and the actual behaviour measured. The most likely explanation is that mandatory regulations create two distinct types of intention: first, intention stemming from evaluations of attitudes and norms, referred to as authentic intention, and intention stemming from compliance with regulations, referred to as compliance intention. When these two are mixed in survey measurements, the results become less coherent and predictive. Individuals whose intentions stem more from regulatory compliance (rather than internal attitudes) may report high intentions; however, when supervision is absent or when the situation does not require compliance, their actual behaviour may be significantly lower than their reported intentions.

⁶⁵ Nguyen et al., "Community-Based Environmental Attitudes and Waste Management Behaviour."

The high correlation between the intention and behaviour variables in Indonesia ($r = 0.610$) and Iran ($r = 0.570$) indicates that, in both countries, intentions are purely based on public awareness. When someone in Indonesia has a strong intention to sort waste, even in the face of infrastructure limitations, that intention tends to reflect a commitment to genuine values, resulting in a stronger correlation with actual behaviour. This is consistent with Ajzen's⁶⁶ argument that intentions stemming from strong internal attitudes exhibit greater temporal stability and are more predictive of behaviour compared to those formed by external pressure. Overall, this study demonstrates that there are differences in program outcomes and sustainability. Programs or activities aimed at building intentions based on internal values (through environmental education, the formation of a pro-environmental identity, and value-based communities) will result in a higher and more sustainable conversion of intentions into behaviour compared to programs that rely solely on mandatory regulations. Mandatory regulations may be effective for achieving short-term compliance, but they do not build the value foundation necessary for long-term sustainable behaviour.⁶⁷

C. A Synthesis of Five Operational Models of the SDGs

Based on the construct-by-construct analysis above, this study identifies five distinct "TPB operational models", that is, the specific ways in which TPB constructs interact and shape waste management behaviour in each country. Understanding these operational models is crucial for designing targeted interventions. The model applied in Vietnam shows that subjective norms formed through community interventions based on shared economic interests are the primary driver. Attitude change is a product of collective norms, while the causal chain begins with community interventions that reinforce subjective values, thereby leading to attitude change. Continuous attitude change will lead to changes in behaviour/actions regarding waste management. Attitude change can also be driven by simultaneously strengthening PBC through the provision of facilities within intervention programs. Behavioural change differs when examining studies of the model in China due to the existence of so-called mandatory rules/regulations related to waste management. In this case, regulations replace the role of changes in attitude and subjective norms that generate "intention." In this model, TPB is viewed through the lens of regulations that generate intention, thereby changing public behaviour. Significant changes in attitude or PBC do not accompany this behavioural change. A fundamental weakness of this model is the absence of a strong internal value foundation, making behaviour highly dependent on the consistency of regulatory enforcement. This model is effective at creating rapid, uniform behaviour but is vulnerable to backsliding when regulations weaken or oversight diminishes.

⁶⁶ Ajzen, "Perceived Behavioral Control, Self-Efficacy, Locus of Control, and the Theory of Planned Behavior."

⁶⁷ Edward L. Deci and Richard M. Ryan, "The 'What' and 'Why' of Goal Pursuits: Human Needs and the Self-Determination of Behavior," *Psychological Inquiry* 11, no. 4 (2000): 227-68, https://doi.org/10.1207/S15327965PLI1104_01.

The Indonesian model can be referred to as the 'Attitude-Constrained TPB'. Here, a positive attitude has already formed ($M = 4.15$). Still, low PBC due to infrastructure limitations creates a significant barrier in the attitude chain, thereby affecting the emergence of intention and altering behaviour. In this model, the pattern of causality is a positive influence (attitude), but the absence of adequate facilities (weak PBC) results in intention remaining at a moderate level. This condition ultimately leads to inconsistent behavioural change. The gap between attitude and behaviour is very large because the formed intention often cannot be carried out due to inadequate facilities. The most effective intervention here is one that improves PBC through infrastructure investment, rather than one that further increases an already high attitude.

The Iranian model can be referred to as the 'Moral Obligation-Extended TPB'. Here, moral obligation derived from religious values serves as an additional variable that significantly strengthens attitudes and can even accelerate the formation of subjective norms, thereby serving as a predictor of intention. The dominant causal chain involves religious values generating moral values, which in turn lead to significant changes in attitude. This is reinforced by strong infrastructure, which generates strong intentions and drives behavioural change. A unique characteristic of this model is that the motivation for pro-environmental behaviour does not depend on external social pressure but rather on internal value commitments rooted in religious beliefs, making it more stable and consistent across various social conditions. The Japanese model can be termed "Post-TPB Habitual Compliance". Here, waste management behaviour has moved beyond the deliberative pathway of TPB and entered an automatic habitual pathway. The chain of cause and effect applies not only to attitudes, intentions, and behavioural changes but also to social values (the culture of shame), changes in habits, and automatic changes in actions or actors. In this model, measuring attitudes through questionnaires no longer represents the true motivation behind behaviour, as behaviour is no longer mediated by conscious attitude evaluation. This model represents the ideal final stage of a mature waste management system, where behavioural compliance no longer requires significant deliberative effort.

D. Methodological Bias and Measurement Limitations in a Cross-Cultural Context

In addition to substantive psychosocial mechanisms, several methodological issues should be considered when interpreting cross-national differences in environmental attitude scores. First, acquiescence bias, the tendency to agree with statements in a questionnaire without deeply considering their content, is known to be more common in some Asian cultures compared to Western cultures.⁶⁸ If this bias is higher in Vietnam or Indonesia than in Japan, some of the score differences may reflect differences in responses rather than substantive differences in attitudes.

⁶⁸ Anne-wil Harzing, "Response Styles in Cross-National Survey Research: A 26-Country Study," *International Journal of Cross Cultural Management* 6, no. 2 (2006): 243–66.

Second, desirability bias can have different effects across cultures. In countries where environmental issues feature prominently in public discourse, for example, due to intensive government campaigns or highly visible environmental problems, respondents may tend to report more positive attitudes than they actually hold, as pro-environmental attitudes are the “socially expected” response. This phenomenon may partly explain Vietnam’s high scores, where community interventions may also create social pressure to provide the “correct” responses in surveys. Third, the baseline comparison effect must be critically considered. When Vietnam is used as a baseline, it is important to note that the measurement context in Nguyen et al.’s⁶⁹ study, which focused on tourism communities that had undergone intensive community-based interventions, likely yielded scores that do not reflect the Vietnamese population as a whole. Communities that have received intensive interventions experience what is known as the impact of repeated actions/policies, namely changes in attitudes and behaviours caused by the intervention itself, rather than by the baseline conditions of the general Vietnamese population. This sample selection bias constitutes the most serious methodological limitation in this study. Fourth, differences in the operationalisation and measurement instruments for environmental attitudes across the primary studies may result in measures that are not fully conceptually equivalent. Although all studies claim to use the TPB framework, the scales and items used may differ in terms of wording, dimensions covered, and reference context. A meta-analysis using a Random-Effects model partially accommodates this variation through heterogeneity estimates; however, measurement non-equivalence remains a limitation that cannot be fully eliminated without conducting a cross-cultural Confirmatory Factor Analysis (CFA).⁷⁰

E. Implications of High Heterogeneity and Moderator Factors

The very high I^2 values (97.6–98.27%) across all analyses confirm that country context is a strong moderator of the relationship between TPB variables and waste management behaviour. This extreme heterogeneity also underscores the need for caution when generalising findings from one country to another, even within the geographically contiguous Asian region, and for in-depth contextual consideration to accompany such generalisations. Based on a substantive analysis of the characteristics of the countries in the study, at least four categories of moderator variables can be identified: (1) level of economic development and maturity of waste management infrastructure; (2) dominant cultural type (collectivist vs. individualist, shame culture vs. guilt culture, biosentric vs. egocentric orientation); (3) the type of waste management policy in effect (mandatory regulations vs. community-based voluntary approaches); and (4) the level of visibility of waste issues in people’s daily lives. The implications of these findings regarding heterogeneity are crucial for research design and policy formulation. From a research perspective, studies are needed that explicitly test the role of these moderator variables

⁶⁹ Nguyen et al., “Community-Based Environmental Attitudes and Waste Management Behaviour.”

⁷⁰ Fons J. R. van de Vijver and Kwok Leung, *Methods and Data Analysis for Cross-Cultural Research* (SAGE Publications, 1997).

using subgroup analysis or meta-regression. From a policy perspective, these findings provide strong empirical justification for the design of contextually tailored waste management interventions that cannot rely on a one-size-fits-all approach.

F. Psychosocial Profiles of Each Country and Recommendations for Intervention

Based on a synthesis of all findings, specific psychosocial profiles and tailored intervention recommendations can be formulated for each country. For Vietnam, the primary strength lies in its ability to develop collective social norms that support pro-environmental behaviour through community-based interventions. The appropriate strategy is to replicate and scale up community intervention models aligned with local economic interests, particularly in areas economically dependent on environmental quality, such as tourist areas, coastal zones, and agricultural regions. For China, the main challenge is to transform compliance-driven behavioural adherence into an internalised commitment to values. The recommended approach includes school-based environmental education programs starting at an early age, as well as community engagement programs involving influential social groups to strengthen subjective norms that support waste sorting behaviour.

For Indonesia, the top priority is to bridge the attitude-behaviour gap by improving infrastructure and access to sorted waste management services. As PBC increases due to adequate infrastructure, existing positive attitude scores will be more easily converted into actual behaviour. Investments in waste bank systems, curbside collection services, and waste reporting apps will directly boost the public's PBC. For Iran, the most effective approach is to frame environmental messages within the context of religious values and moral obligations. Collaborating with religious institutions, such as mosques and clerics, to spread the message that protecting the environment is a manifestation of faith can be a highly effective and far-reaching strategy. For Japan, policy priorities should not focus on increasing explicit attitude scores (which are no longer relevant because the behaviour has been internalised), but rather on technological innovation in recycling processes and waste reduction at the source, as well as the export of knowledge and governance models to other Asian countries that are still in the phase of developing waste management systems.

VII. CONCLUSION

This study, which employed a comparative meta-analysis approach, yielded several key findings that make significant theoretical and practical contributions to the literature on environmental behaviour and waste management in the Asian region. First, a standard meta-analysis of the relationships among variables in the Theory of Planned Behaviour confirmed a significant positive correlation ($r = 0.348$; 95% CI: (0.263; 0.434); $p < 0.001$) between TPB variables and waste management behaviour in the Asian region. This finding affirms the validity and relevance of TPB as a theoretical framework for

understanding environmental behaviour in the Asian context. However, the very high heterogeneity ($I^2 = 98.27\%$) indicates that the strength of the relationships varies substantially across countries and between variable pairs. Second, a comparative analysis using Cohen's d revealed highly significant differences in environmental attitude scores across five Asian countries ($p < 0.001$ for all comparisons; overall $d = 1.076$). Vietnam ranked highest, followed by Iran, China, Indonesia, and Japan. This ranking does not reflect actual levels of environmental concern but rather differences in the psychosocial mechanisms underlying environmental attitude formation and expression across cultural contexts.

Third, the extreme disparity between Vietnam and Japan ($d = 1.971$) is interpreted as a manifestation of two fundamentally different psychosocial mechanisms: in developing countries, pro-environmental attitudes are reactive-deliberative in nature, triggered by the visibility of waste problems; whereas in developed countries like Japan, pro-environmental behaviour has been internalised into habitual compliance that no longer requires intensive explicit expression of attitudes. Fourth, the very high heterogeneity ($I^2 > 97\%$) across all analyses confirms that country context, encompassing development level, cultural type, waste management policies, and the visibility of environmental issues, constitutes a strong moderator. The implication is that a one-size-fits-all approach to waste management campaigns and policies in the Asian region will not be effective and must be replaced by a contextual and adaptive approach.

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